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THE DYNAMIC VALUE OF CONTENT

IN all discussions of the relation between mind and body and of the three main theories (parallelism, interactionism, and double aspect theory) and their variants, it is assumed that we have to deal with *two* series of phenomena, the physical or neural process and the psychic process. This is evident not only in the earlier discussions, but in such later ones as are contained in McDougall's "Body and Mind," Münsterberg's "Psychology, General and Applied," Parmelee's "Science of Human Behavior," etc., not to mention Warren's presidential address on "The Mental and the Physical"[1] and various other contributions. It is obvious that there is *some* connection between mind and body—hence the persistence of the efforts to explain it. The failure of any of the main theories or their variants to find general acceptance is due to the fact that they are either wrong or incomplete.

I do not need to describe the theories or the controversies over them, but will state at the outset that I shall try to show that all three theories are incomplete, since all posit only a *dual* series of phenomena; that there is in reality a *triple* series, *neural* process, *psychic process,* and *psychic* CONTENT; and that there is interaction among them. It is the failure to distinguish between the psychic *process* and the psychic *content,* and the almost universal use of the former when the latter is meant, that has retarded the solution of the problem.

Analysis of a concrete example will best illustrate this contention. Let us see what actually happens and trace somewhat minutely step by step as well as we can the successive events that occur when we examine the pupillary light reflex in a patient.

When light from a match held in front of the eye falls on the retina, movements are set up in the protoplasm of some of the retinal cells, *i. e.,* light-energy is transformed into, or sets free, energy of motion and probably chemical energy. So much we know, for pigment changes its position in the cells, and if the cells are stimulated long enough they undergo observable katabolic changes. Beyond this we can only infer. But reasoning from many facts we can justifiably infer that some activity of these retinal cells acts as a stimulus to the two sets of neurones in the retina with which they are in synaptic relation, the one laterally, the other internally. Doubtless certain of these set into activity (either by transformation or liberation of energy) some of the neurones, still within the retina, with which they are connected, and from which axones extend in through the optic nerve to three groups of cells in and near the optic thalamus.

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[1] *Psych. Rev.,* Vol. 21, p. 79.

From one of these groups the stimulation is passed on through two or three successive sets of neurones, the last of which has its endings in the ciliary muscle fibers, and the pupil contracts. This is the light reflex, a pure reflex, unaccompanied by any awareness on the patient's part. It is not a psychological phenomenon, and is not regarded as a manifestation of mind.

At the thalamus certain neurones are stimulated to activity and the patient *senses "light"* (as distinguished from sound or other kind of sensation). This is the first of the psychic reactions.

From about this region the stimulation travels by two other nerve paths. The first leads through certain motor neurones, of which one branch traverses the facial nerve to the eyelids, whereupon the man *winks,* and of which another goes to various muscles, whereupon the man *converges* the axes of *his eyes* upon the point of light, *turns his head* a little, etc. These are reflexes, but the man is aware of them, and may be able to control them. (I will not undertake to trace the paths of neurones involved in the awareness or the control.)

The second nerve path leads to the cuneus in the posterior lobe of the brain, whereupon the man *sees "a light"* (perhaps "a yellow light at the end of a stick"). This is the act of perception, and it seems to be here that the record of percepts is made which are subsequently recalled as memory-images of things seen.

It may be also that from the region of the thalamus, where the man *senses "light,"* stimulation of unknown sets of neurones occurs, whereupon the man *feels "startled,"* and thence the stimulation is transmitted through motor cells in the cord to certain voluntary muscles (the man jumps), and through certain autonomic and sympathetic paths to the heart, blood vessels, and other organs (the heart beats irregularly, the face blanches or flushes a trifle, etc.). But this is aside from the main path which I wish to follow out, and I shall not refer to it again.

From the cuneus connections are made either directly or through the mediation of one or more sets of neurones with all parts of the cerebral cortex. We know little or nothing about the specific functions of most of them. But it seems a justifiable inference that functional activity of some group or other must subserve the purpose of each psychic event. On this supposition I shall continue to detail the patient's reactions.

From the cuneus unknown cortical neurones are stimulated, and the man *apperceives* the "lighted match held before his eye," *recognizes* the physician, and *recalls* a similar experience of a few days before.

From the cuneus and these other cortical neurones other unknown cell-groups are activated and he *feels* "annoyed" at the light and at the physician for holding the lighted match before his eye.

From the cell-groups which subserve his feeling of annoyance widespread stimulation of other neurones extends in three main directions,—(1) the sympathetic-autonomic system, affecting heart, blood vessels, etc., (involuntary expression of emotion); (2) cortical and other motor centers, resulting in his scowling, etc., (voluntary instinctive expression of emotion); and (3) other cortical areas which subserve his *thinking* "that he won't stand such tricks," and thence to those subserving his *thinking* of "striking the physician, or pushing the match away, or blowing it out."

Some cortical cells doubtless subserve his making a choice among the alternatives, and probably others his determination to carry out the plan decided on. According to the choice made, certain motor neurones are activated and he puts out his hand and pushes away the match.

There are innumerable other physical occurrences which it would only be tedious to describe and which are unnecessary for the argument.

In all these reactions *neural, i. e.,* physical, *process* is obviously necessary. Some mode or modes of energy are at work, transmitted from neurone to neurone or set free in one by the action of the preceding one. Unless this were so, we would have activity arising *de novo*—something coming out of nothing—a state of affairs which we find nowhere else in nature, and which should therefore require indisputable proof to convince us that it exists here. The facts that we can not measure it, or change it to other better known modes, or even detect it, except by its results in behavior, are not such proofs. They only mean that our means of investigation are still too crude. We may look on the nerve-cell as a station for the transformation of one mode of energy into another, as a battery cell is a station for the conversion of chemical energy into electricity. It is a hypothetical energy whose mode we do not know. We can only call it *neural* energy, or energies. Since the neurones in the chain which leads to the reflex contraction of the pupil never subserve sensation as such, we must assume that they are incapable of doing so, *i. e.,* incapable of the mode of activity necessary for it, and hence have a different mode of activity or energy or a different range of vibration- or radiation-rate or whatever mode it may be, from those which subserve sensation, etc.[2]

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[2] In this connection it would be interesting to see if a muscle-stimulatory effect could be elicited if the sensory ganglia of the cord should be connected directly with the motor nerves (thus eliminating the motor cell body) and the sensory end organs excited by their appropriate stimuli.

We see from experiments and clinical observation that the neurones which subserve sensation can not, or at least never do, subserve thinking, willing, executing, etc. We must assume then that each set has its own specific wave-rate or wave-length, or whatever may be its mode.

In the pupillary light reflex there is, so far as we know, no other than neural energy till the muscle cells are reached, where the last neurone sets free energy of motion.

But as soon as we begin to have the *psychic* reactions which we saw in the illustrative case, namely, sensing, perceiving, thinking (of different kinds, as recognizing, recalling, planning, choosing, etc.), feeling (*i. e.*, emoting), willing, another order of phenomenon is introduced. These activities are different from the neural processes on which they depend.

That they are *activities,* manifestations of energy, is evident from the fact that they finally result in muscular *movements* which would not have occurred but for them. If the man had not *sensed* the light, if he had not *felt* and *thought* as he did, etc., he would not have *acted* as he did. That we can and do use transitive verbs, either expressly or by implication, in referring to these activities, while in no sense a proof that they *are* activities, indicates that we regard them as such.

That they are not identical with neural process, nor yet with the nerve cells, though conditioned on them both, hardly needs to be stated. Such identification would be equivalent to that of the locomotion of an engine with the movements of its parts and with the engine itself.

That there are not *two aspects of the same thing* is evident when we consider that we can speak of two aspects only when the aspects are of the same order of phenomenon, and these are shown to be different. McDougall[3] has gone into these points quite exhaustively.

But what modes of energy are they? We must answer, as in the case of neural energy, that it is a hypothetical one, whose modes we do not know. To give them a name we may call them *psychical* energies, and subdivided by calling them sensing, thinking, etc., energies.

What are the relations between the neural orders and the psychical orders? Psychical activity is never seen in the higher animals except in connection with nerve-cells and presumably their activity, and this takes the form of discharge of neural energy. Since we seem justified in considering the psychic activities of sensing, thinking, etc., as modes of energy, are we not forced to the conclusion that while part of the neural energy is transmitted to or transformed in other cells, a part is converted into these forms of psychic energy—perhaps as chemical energy in the battery is converted into electric energy, or as motion is converted into electricity in the dynamo, or electricity into light and heat in the light bulb. This is the more probable, as in the conversion of one mode of energy into another, it is almost always into more than *one* other—in the dynamo, for example, there is always friction developing heat, there is sound, and there are currents of air, etc. It is probable, too, that since the neurones which subserve sensing never subserve thinking or willing, for example, there is marked specificity of both neural and psychic energies. We know of nothing that can give rise to psychic energies except neural energies (unless perhaps in the unicellular organisms), *i. e.,* there is no psychic process without neural process. Whether the converse is true, and *specific* neural activity occurs in the cells which subserve mental functions without giving rise to its corresponding psychic activity we do not know, though it is undoubtedly true that *nutritional* (chemical) changes take place in the nerve-cell without giving rise to psychic acts.

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[3] *Cf. Body and Mind.*

Mental activity is not fully described if we stop at neural process and psychic process. It tells us little of the man's acts if we say he sensed, perceived, apperceived, remembered, thought, felt, planned, decided, and acted. We want to know *what* he did in each of these activities.

We can not act without doing *something.* We can not sense or have a sensation, without sensing something, having a sensation of something; we can not think without thinking something. There is no such thing as mere abstract thinking or feeling or acting. We always sense "light" or "sound" or "warm," etc. We always perceive "a light" or "a sound" or "a warm thing." We always think definite thoughts. We always feel "annoyance," "surprise," "anger," etc. These are the *contents* of the various psychic activities or processes.

This content is not the same thing as the process, for to some extent they may be altered independently of each other. For example, in Trotter's and Davies's experiments on cutaneous sensation[4] the stimulus applied to a definite point of skin gave the sensation "warm"; when the temperature was raised above 100 degrees F., the sensation suddenly became "hot," and when raised above 120 degrees F., it became "pain," indistinguishable from that of a needle prick. Here the same neurones and the same psychic process were involved, but with a changing content. On the other hand, in the psycho-motor retardation of manic-depressive psychosis the thinking process as process may be much slowed without alteration of the content as train of thought. This can be demonstrated in the continuous subtraction of 7 from 100, the patient using the same method of subtracting as when he is well and able to do it much more quickly.

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[4] *Jour. Physiol.,* Lond., Vol. 38, p. 134.

Psychic process and psychic content are perfectly distinguishable, but are inseparable. Just as we can not have pure sensation without content, neither can we have any content without a process of which it is the content. This inseparability makes one again question whether we may not be dealing here with two aspects of the same thing. But, as before, we are dealing with phenomena of different orders, and we can not therefore properly speak of them in that relationship to each other.

What then are their relations to each other? McDougall[5] cites the telegram incident—a man receiving a telegram from a friend reading, "Your son is dead" or "Our son is dead"—to show that *meaning* has an effect on behavior. And he says, "Meanings are . . . essential links between sense-impressions and the behavior they evoke" (p. 311). Meaning in his usage is sometimes equivalent to content as I have used it here; sometimes it has a vaguer, larger, more inclusive connotation. But in such places it includes and is equivalent to the content of several processes (affects, trains of thought, complexes). He thus sees a dynamic value in meaning (hence in content), but can not explain it (p. 271), and still sees only *two* orders of phenomena involved in the problem.

My purpose in citing in such detail the reactions of the patient is to bring out clearly not only the neural processes and psychical processes, but the *content* as well, and especially its dynamic value. There it is seen that in each of the reactions ending in pupillary contraction, neural process alone as stimulation of one by the preceding one was sufficient to account for the end result. But from the time of stimulating the cells in the thalamus and the inauguration of psychic *processes* with their inseparable *contents* it is the latter which determine specifically what each of the succeeding reactions shall be. It was not *sensing* as such that determined the winking, the convergence of eye-axes, the turning of the head, but its content *light*. It is true that these are largely automatic and instinctive reactions and might occur in approximately (though not exactly) the same way as the result of any rather sudden intense sensory stimulus of other kinds, as of sound or pain, and it is perhaps possible that at this level sensation as such, regardless of content, may be sufficient to determine these "thoughtless" acts, if I may so call them. It is the

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[5] *Body and Mind,* p. 268.

content of the sensation "light" that is the determinant of the percept "a light"—had the content of the sensation been different, the percept would have been different. It is the *content* of the percept that determines the apperception of the "lighted match before his eyes" and the recollection of a previous similar experience. It is the *content* of the thinking or of the sensing (perhaps both) that makes him feel annoyed. It is the *content* of the affect of *annoyance* that makes his heart beat faster, the scowl come on his face, and the thought arise that he won't stand such tricks, etc. If he had felt *amused, i. e.,* if the *content* of his affect had been different, a wholly different train of bodily and mental reactions would have occurred, through a wholly or largely different set of neurones. It is the *content* of his thinking (that he wouldn't stand such tricks; that he would strike the physician or push the match away or blow it out) that led to his choosing the second plan and deciding to carry that out. It was the *content* of the plan and the *content* of the decision that led to his actually pushing the match away. In no case, unless possibly in the automatic instinctive acts, was it the psychic *process* as such that led to the subsequent reactions.

It can also be shown that content determines to some degree the extent or the intensity, or both, of other mental activities and of conduct.

Content thus enters dynamically into the causal series of reactions that lead from sensation to behavior. Since nowhere else in nature do we see energy set free without some antecedent energy to give it a push, as it were, we are driven to the conclusion that psychic content is some mode or modes of energy. Since we find it inseparably associated with psychic process, and since we do not see it giving rise directly to psychic process, we must assume that psychic process gives rise to it; that is, that psychic energy is transformed into or sets free content-energy, probably the former. This content-energy then serves as a director or selective stimulator, or perhaps as a liberator of neural energy. It is perhaps Max Meyer's "ghost" of a few years ago.[6] How this directive function is carried out is a problem for future investigation.

The real relationships that exist among the three sets of phenomena may be shown diagrammatically, after the analogy of McDougall's diagrams illustrating the different psycho-physical theories.

Fig. 1 represents the side view of the succession of events in the case cited. The dark circles represent the neurones and the neural energy subserving the psychic processes. The light circles represent the psychic processes of sensing, perceiving, etc. The squares represent the psychic contents. The lines represent the direction in which energy is propagated.

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[6] This JOURNAL, Vol. 9, p. 365.

Fig. 2 represents the same events in bird's-eye view, as a map or plan. Neurone connections are shown by lines connecting the dark circles. The actual path taken in the case cited is indicated by the double lines, of which one connects the neurones, the other represents the selective influence of the content. The possible paths not taken are represented by the square-and-circles from which no lines radiate. Energy is propagated from left to right.

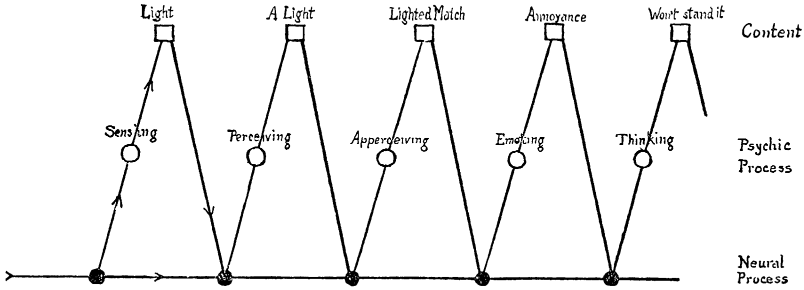

FIG. 1

Thus the parallelists are right to the extent that there are parallel series of events, and the interactionists are right to the extent that there is interaction between the parallel lines. But both are incomplete in that they fail to recognize that one of their lines, psychic process, is in reality two lines, (1) psychic process in a stricter

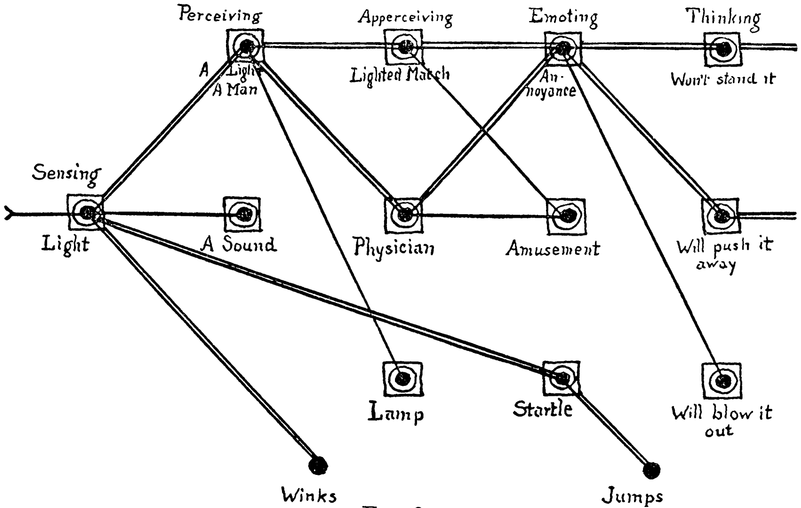

FIG. 2

sense and (2) psychic content, and that the psycho-physical relationship consists of a triple series, not a dual one. The double aspect theory seems not to have a leg left on which to stand.

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REVIEWS AND ABSTRACTS OF LITERATURE

Fundamental Conceptions of Modern Mathematics—Variables and Quantities. ROBERT P. RICHARDSON and EDWARD H. LANDIS. Chicago and London: The Open Court Company. 1916. Pp. 216.

This is the first instalment of what threatens to be a very large work. The authors have divided that part of their subject which deals with "Algebraic Mathematics" into thirteen parts, of which the present volume is Part One. The important arguments in this book have been published in the *Monist*[1] under the title "Numbers, Variables, and Mr. Russell's Philosophy."

In this review only the logical and philosophical aspects of the book will be considered. Concerning a few of the more technical mathematical discussions in it I do not care to pronounce judgment, though I may mention the fact that when I persuaded a certain eminent mathematician to read it, his condemnation was too severe to be printed.

The authors of a work dealing with the Philosophy of Mathematics might be expected to be thoroughly acquainted with the works of Frege, Schroeder, Peano, Couturat, Poincaré, Whitehead and Russell. Frege has been at least partially read, but without understanding.[2] The only indication that our authors have read Peano or Schroeder is a statement concerning Frege that "as a logician he can not be ranked above the level of Schroeder or Peano."[3] Neither Couturat nor Poincaré is mentioned. Russell's *Principles* of 1903 has been read with partial understanding, but no reference at all is given to the first volume of the *Principia Mathematica* which has been before the public for about six years. One wonders when this work was written.

There are perhaps three points on which it can be commended. In the first place it points out many confusions and examples of carelessness in mathematical definitions, especially concerning num-

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[1] July, 1915, Vol. 25, pp. 321–364.

[2] P. 60.

[3] P. 152, note 2.